ENDOSCOPIC MEASUREMENT DEVICE TO MONITOR TUMOR GROWTH IN VIVO

Clients: Dr. William Dove, Dr. Jim Amos-Landgraf, Amy Irving – UW Dept. of Oncology

Advisor: Amit Nimunkar

Leader: Blake Marzella

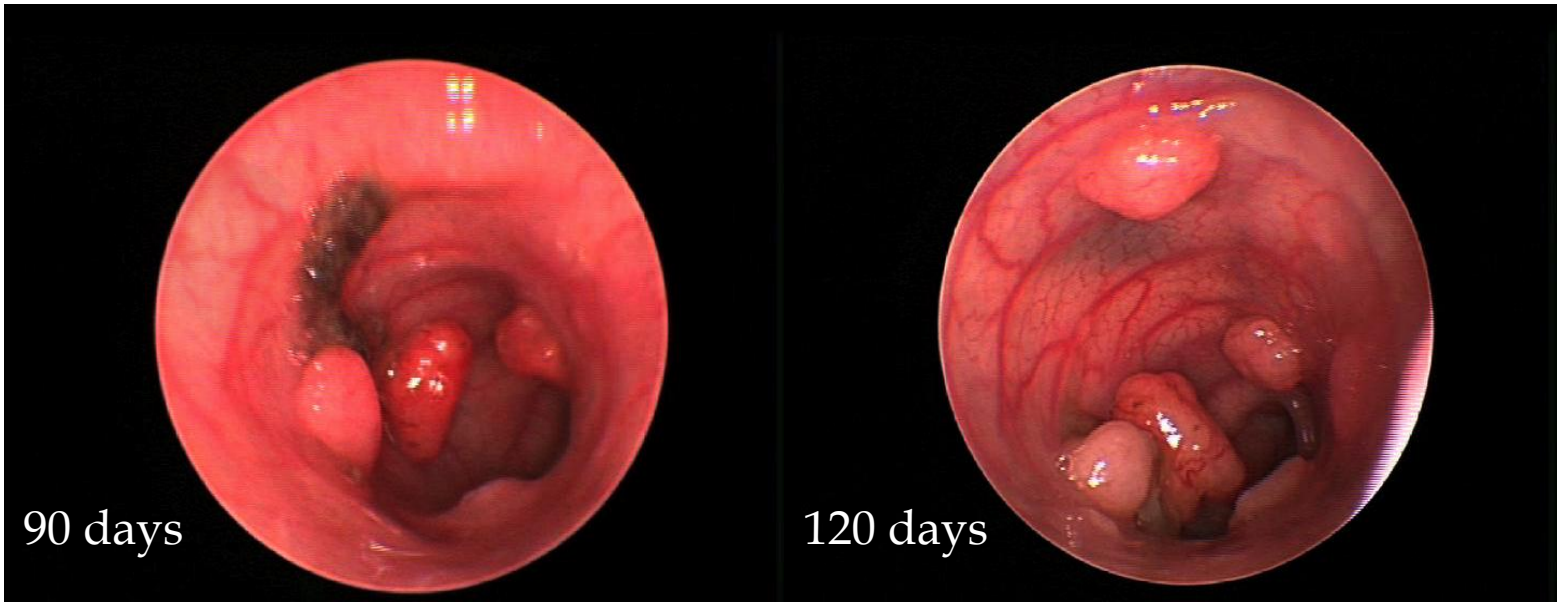
Communicator: Justin Cacciatore

BWIG: Mike Nonte

BSAC: Mike Konrath

Background

- Colorectal cancer
- Animal model with rats and mice
- Colonoscopy



Current Devices

- Rat Endoscope: Storz 7219BA
- Mouse Endoscope: Storz 1232AA
- Lens Creates a fish-eye distortion
- No way to determine quantitative size of objects in the image

Problem Statement

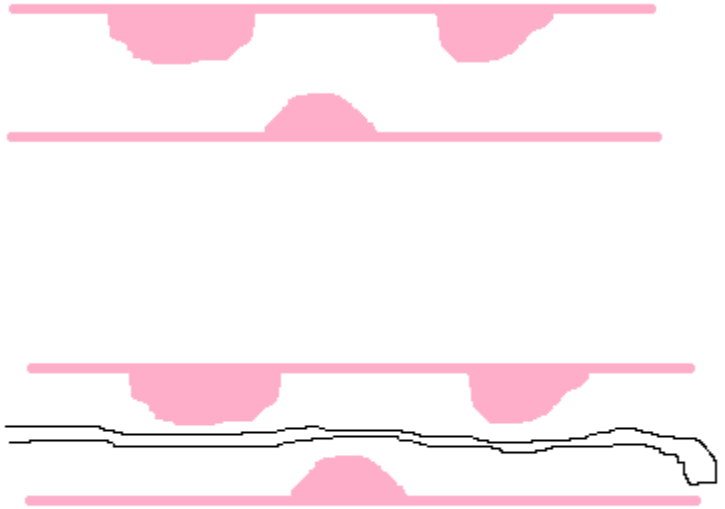
- No quantitative measurement, in vivo
- Measure tumor response to drugs
- Volume change
- Diameter, Cross-sectional area

Client Requirements

- Must not harm tumor, animal
- Relative volume changes over time
- 10 – 15% error acceptable
- $1000 budget

Alginate Cast

- Insert an angioplasty balloon into the colon



Alginate Cast Cont.

- Inflate balloon to create blockage

- Fill blocked off area with alginate.

- Allow to gel

Alginate Cast Cont.

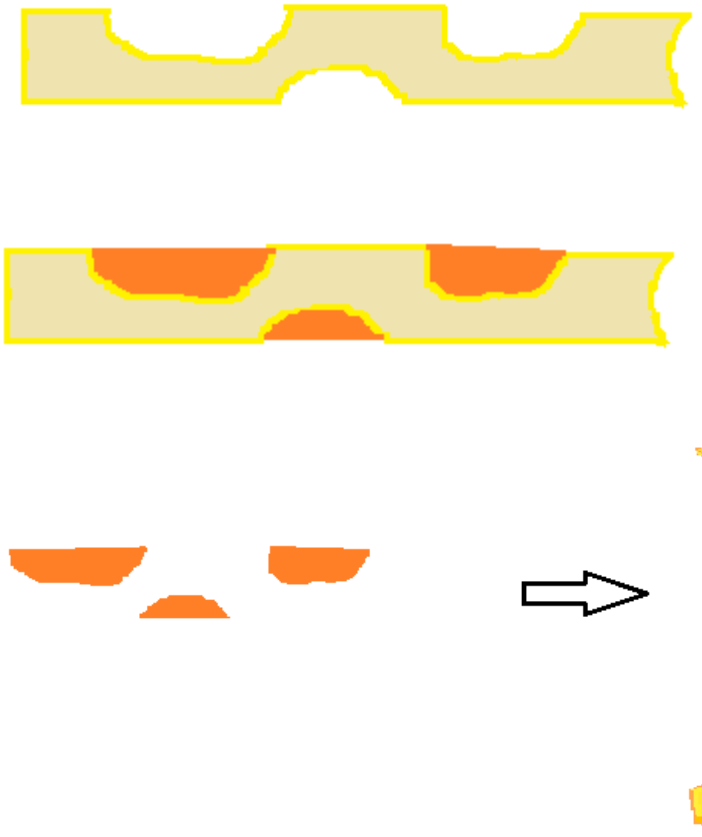
- Deflate balloon

- Alginate detaches from colon walls

- Remove gel

Alginate Cast Cont.

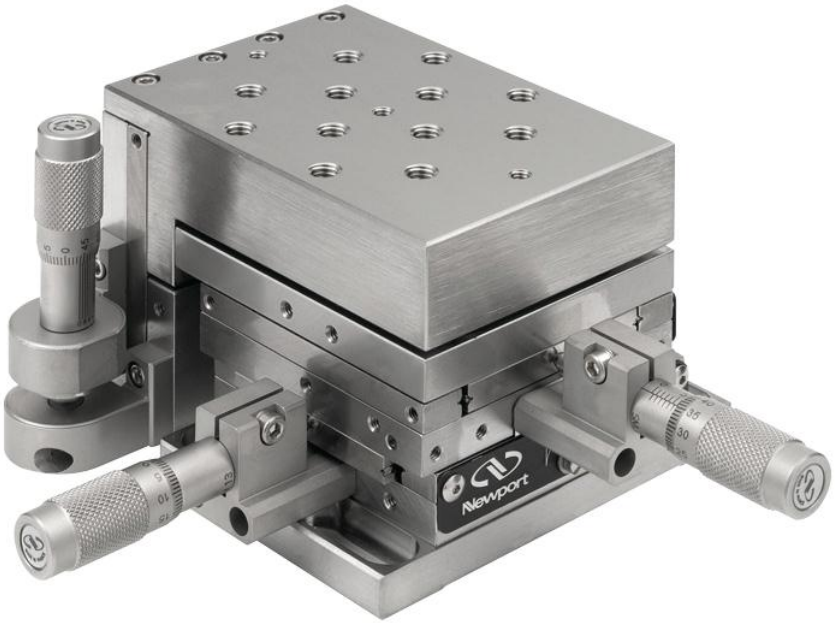
- Fill tumor casts with clay to make molds of each tumor



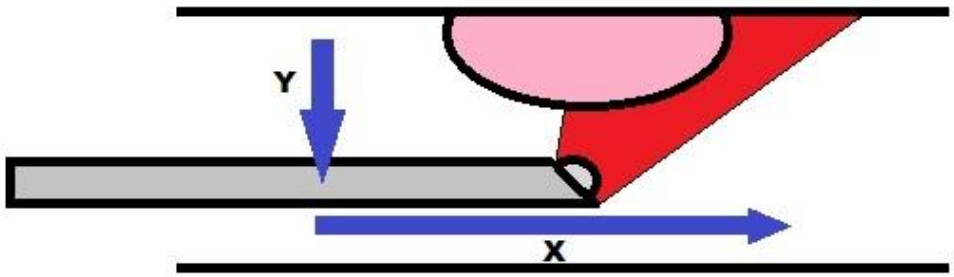
- Assess volume of clay tumors with graduated cylinder

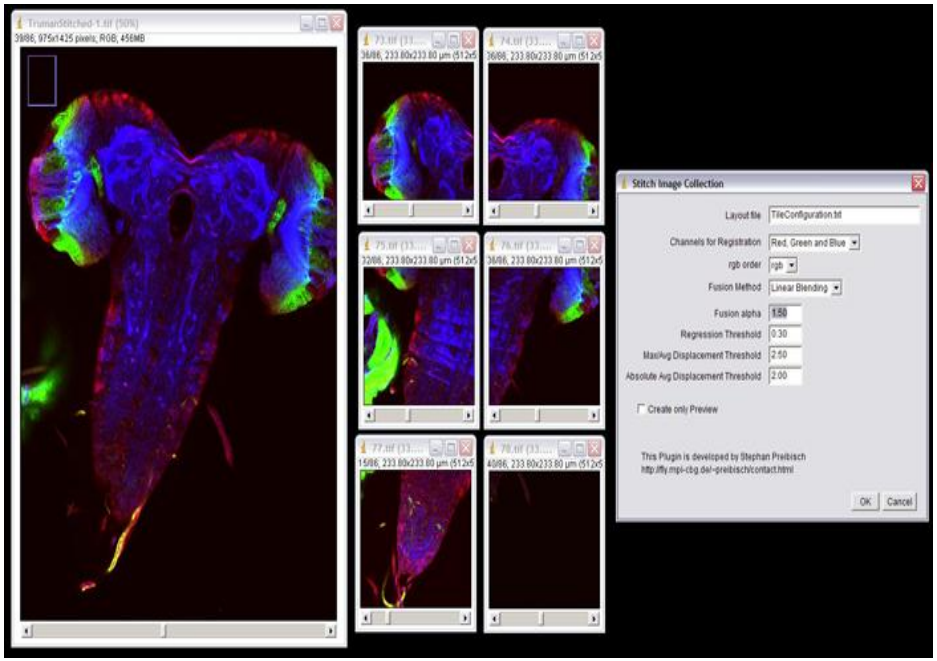
3D Image

- Apply filtering to correct for fisheye distortion
- Attach endoscope to moving stage with micrometer to know precise movements of the device



3D Image Cont.

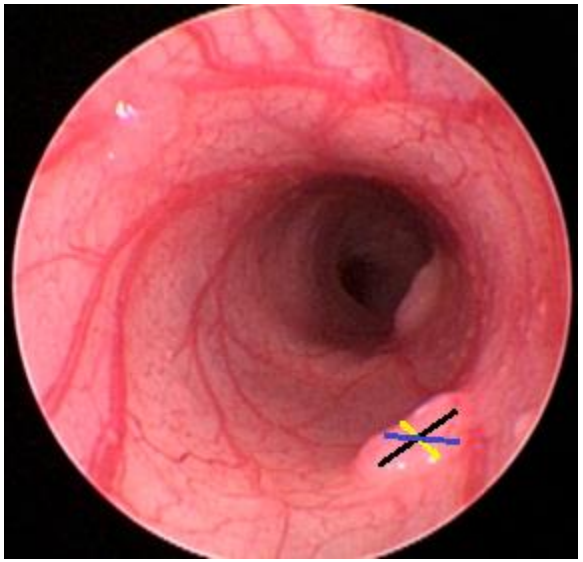




- Take several images while moving in a line in a defined y axis and defined x axis
  - Measure exact location of endoscope at each point
- Use ImageJ software to stich together images into a 3D mesh
- Use 3D image analysis software to determine volume of tumor

Physical Measurement

- Model as Ellipsoid
  - $V = 4\frac{\pi}{3}R_1R_2R_3$
- Caliper device through working channel
- Need to modify equation
  - Determined experimentally
  - Animal sacrifice
- Harder for smaller, flat tumors



Final Design Selection

	Ease of Procedure	Time Requirements	Cost	Estimated Accuracy	Adherence to Protocol	Repeatability	Potential Damage to Tumor	Applicability to Different Tumor Shapes	Resolution	Total
Maximum Points	10	10	5	15	5	15	15	10	15	100
Alginate Cast	8	8	2	12	1	12	6	8	15	72
3D Image	4	3	5	9	5	8	15	8	10	67
Physical Measurement	5	5	1	7	5	6	12	7	5	53

- We will be moving forward with the alginate cast idea
  - Simplicity
  - Accuracy
- However, the 3D image idea is still an option

Future Work- Alginate Cast

- Acquire alginate and test properties
  - Gel time
  - Preparation time
  - Consistency
  - Elasticity
- Test procedure on straw model
- Purchase angioplasty balloons
- In Vivo testing

Future Work- Image Analysis

- Find Program to fix “fish-eye” problem
- Test Image J stitching and analysis on shape of known volume (ex. a marble)
- Build
  - Stage fixtures
  - “Breadboard”
  - Animal Constraints
- In Vivo testing

Acknowledgements

- Amit Nimunkar
- Dr. William Dove
- Dr. Jim Amos-Landgraf
- Amy Irving
- Keven Eliceiri

References

- Mai, K. et al. 2003. A Simple Technique for Calculation of Volume of Prostatic Adenocarcinomas in Radical Prostatectomy Specimens. In Pathology. 599 – 604
- Kuo, C., and P. Ma. "Ionically crosslinked alginate hydrogels as sca!olds for tissue." *Biomaterials*. 22. (2001): 511-521. Print.
- stage:
  http://www.newport.com/store/product.aspx?id=140089&lang=1033

  fisheye:
  http://en.wikipedia.org/wiki/File:Panotools5618.jpg

  stitching:
  http://pacific.mpi-cbg.de/wiki/index.php/Screenshots

  endoscope:
  http://www.karlstorz.de/cps/rde/xchg/SID-3DBA1B2C-2A313808/karlstorz-en/hs.xsl/2260.htm

Questions?